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The Vitamin C Potential of Tree Sorrel Extract (Averrhoa Bilimbi) as Latex Coagulant

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ABSTRACT

This research aims to determine the vitamin C potential of tree sorrels (Averrhoa bilimbi) as a natural latex coagulant. The researchers employed the Completely Randomized Design (CRD) method. The method consisted of three repetitions with five treatments, namely negative control (without clotting) and positive control, by administering tree sorrel extract (Averrhoa bilimbi) with a volume of 5 ml, 10 ml, 15, and 20 ml. The researchers tested the vitamin C levels using UV-VIS Spectrophotometry DR 6000 with a wavelength of 265 nm to 271 nm. Furthermore, the data were analyzed using the One-Way ANOVA statistical test and the LSD to determine the most effective volume as a latex coagulant. The quantitative data were the clotting time and latex weight. The results showed that tree sorrel extract could be used as a latex coagulant. The fastest duration (1.18 minutes) and the highest weight (34.30 grams) of latex were found in the 20 ml volume. At the same time, the lowest yield was at a volume of 5 ml with a clotting time of 5.4 minutes and a weight of 18.62 grams.

ABSTRAK: Tujuan penelitian ini adalah untuk mengetahui potensi vitamin C buah belimbing wuluh (*Averrhoa bilimbi)* sebagai bahan penggumpal alami lateks. Penelitian menggunakan metode Rancangan Acak Lengkap (RAL) yaitu terdapat tiga kali pengulangan dengan lima perlakuan yaitu kontrol negatif (tanpa diberi bahan penggumpal) dan kontrol positif diberikan sari buah belimbing wuluh (*Averrhoa bilimbi)* dengan volume 5 ml, 10 ml, 15 ml dan 20 ml. Uji kadar vitamin C menggunakan Spektofotometri UV-VIS tipe DR 6000 dengan panjang gelombang 265 nm – 271 nm. Selanjutnya data dianalisis menggunakan uji statistik *One Way Anova* dan dilakukan uji lanjut BNT untuk mengetahui voiume yang paling efektif sebagai penggumpal lateks. Data kuantitatif berupa waktu penggumpalan dan berat lateks. Hasil penelitian menunjukkan bahwa, sari buah belimbing wuluh dapat digunakan sebagai koagulan lateks. waktu tercepat dan berat tertinggi lateks terdapat pada volume sari buah 20 ml yaitu 1,18 menit dan 34,30 gram. Sedangkan hasil terendah pada volume 5 ml dengan waktu penggumpalan 5,4 menit dan berat 18,62 gram.

INTRODUCTION

Indonesia has enormously wide rubber tree plantations (Bambang, 2016). The size is considered massive and can be an opportunity to fulfill the local community's needs. The products of rubber tree plantations are one of the supports of the national economy (Naibaho, 2015). It can be seen from the number of products made from rubber raw materials, such as tires, mattresses, balls, and other products. Besides, many rubber raw materials are also exported to foreign countries (Claudia et al., 2016). However, the price for rubber materials is low, around 5,000.00 to 6,000.00 IDR per Kg. This condition is a problem for rubber farmers. The widely used latex coagulation is a chemical coagulant that utilizes its acidic nature (Hardiyanty et al., 2013). The acids are acetic acid, liquid smoke, formic acid, sulfuric acid, and TSP (Nasution et al., 2016). Besides the harmful chemical effects, farmers have to purchase it at a high price. Thus, they have to look for alternatives to natural latex coagulation (selpiana, 2015).

Natural coagulation that has been used is gadung tuber, ceramai fruit extract, and palm sap (Farida, 2014). Furthermore, the researchers utilized the ascorbic acid (vitamin C) from the tree sorrel (Averrhoa bilimbi) extract because this fruit is widely available, rarely used, and does not have high economic value. Tree sorrel contains chemicals such as ascorbic acid (Vitamin C), oxalic acid, citric acid, lactic acid, and malic acid, which can coagulate latex (Ruhomally et al., 2016).

The latex liquid is white like milk and contains rubber grains which are colloidal solutions obtained from the tapping of the Hevea Brasiliense plant. Latex contains 25-40% raw materials and 60-70% serum of solutes and water (Edison, 2016).

Latex coagulation is an event that occurs due to the change of the sol phase into a gel assisted by a coagulant. The nature of its acidity influences the latex coagulant process. Latex will coagulate if the electric charge is lowered (dehydration), the pH of latex is lowered (addition of acid H+), and the electrolytes are added (Chusna, 2017).

Previous research examined the vitamin C in pineapple (Farida Ali, Arta Sihombing, 2013), limes (Ali & Suwardi, 2009), and rambutans (Ali et al., 2009). Previous researchers also examined the tree sorrel to manufacture jelly drinks (Agustin et al., 2014), as a bacteria inhibitor (Sulistyani et al., 2018), and as a brown anchovy preservative (Lestari et al., 2017). Previous researchers have studied latex coagulation temperature (*Wulan Noviastuti, 2015*), latex dilution (Vachlepi & Purbaya, 2018), and interlining fabrics manufacture (Luftinor, 2017). Based on the results of the previous studies, latex can be coagulated using an acidic coagulating agent. Therefore, this research aimed at investigating the potency of tree sorrel (Averrhoa bilimbi) vitamin C as a natural latex coagulant.

METHODE

This research was conducted in March 2019 at Kali Rejo Village, Negeri Katon Subdistrict, Pesawaran Regency, Lampung Province. The identification was carried out at the UPT Integrated Laboratory and Center for Technology Innovation, University of Lampung. The tools used in this research were UV-VIS Spectrophotometry DR 6000, six holes wooden test tube rack, 12 mm x 120 mm test tube, 250 ml glass beaker, extractor EJ-150LPK 1.5 liter, 15 cm diameter petri dish, stopwatch, digital scale, 20 cm long spatula, 250 ml Erlenmeyer flask, funnel, and pH meter. Furthermore, the materials used in this

research were tree sorrel (Averrhoa bilimbi), water, and sterile cotton.

This research method was quantitative descriptive using Completely Randomized Design (CRD). The quantitative data included ascorbic acid levels, pH, clotting time, and weight of latex.

The population in this study was tree sorrel (Averrhoa bilimbi) in Kali Rejo village, Negeri Katon subdistrict, Pesawaran Regency. The research sample was taken using the purposive sampling technique. The tree sorrel was extracted as much as 250 ml by putting it in an extractor and measuring the pH using a pH meter. Measurements were made by preparing a sample, then inserting a measuring device and seeing the level of coagulant acidity. The sample criteria of the tree sorrel (Averrhoa bilimbi) were ripe, yellow, or pale yellow and not rotten.

Vitamin C levels were measured using UV-VIS spectrophotometry by adjusting the wavelength range from 265 nm to 271 nm. The researchers coagulated the latex by taking it in the morning to avoid precoagulation. The latex was filtered from impurities, placed in a glass beaker (250 ml), and put into test tubes of 20 ml each. The coagulation was done by adding the extract from the tree sorrel (Averrhoa bilimbi)

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To determine the potential of tree sorrel extract as a latex coagulant, the researchers performed data analysis using the SPSS 17 program. After mixing the latex with the coagulant, the researchers calculated the clotting time using a stopwatch. The researchers measured the weight using digital scales with time variations of 1 hour, 2 hours, 3 hours, 4 hours, and 5 hours to determine the highest latex weight of each coagulant. Each treatment was continued with the LSD test at a level of 0.05.

RESULTS AND DISCUSSION

The pH test found that the tree sorrel (Averrhoa bilimbi) extract has a pH of 1.34. Next, the vitamin C content of the tree sorrel extract was tested based on various volumes: 5 ml, 10 ml, 15 ml, and 20 ml. Each volume was tested using UV-VIS spectrophotometry with a wavelength of 268 nm – 271 nm. The test was performed by first making a series of standard solutions to determine the calibration of the vitamin C standard solution and measuring the absorbance with the maximum wavelength obtained. From these measurements, the concentration of the standard solution of vitamin C can be seen in Table 1.

Table 1. The Concentration of Vitamin C Standard Solution

Concentration (mg/ml)	Absorbance
4	0.494
6	0.719
8	0.937
10	1,153
12	1.335

Table 1 contains the measurement result of various vitamin C solution concentrations standards. The concentrations used in standard solutions were 4 mg/ml, 6 mg/ml, 8 mg/ml, 10 mg/ml, and 12 mg/ml. Furthermore, from the concentration of each standard solution, the absorbance was determined by spectrophotometry. The calibration curve is obtained from these measurements, as displayed in Figure 1.

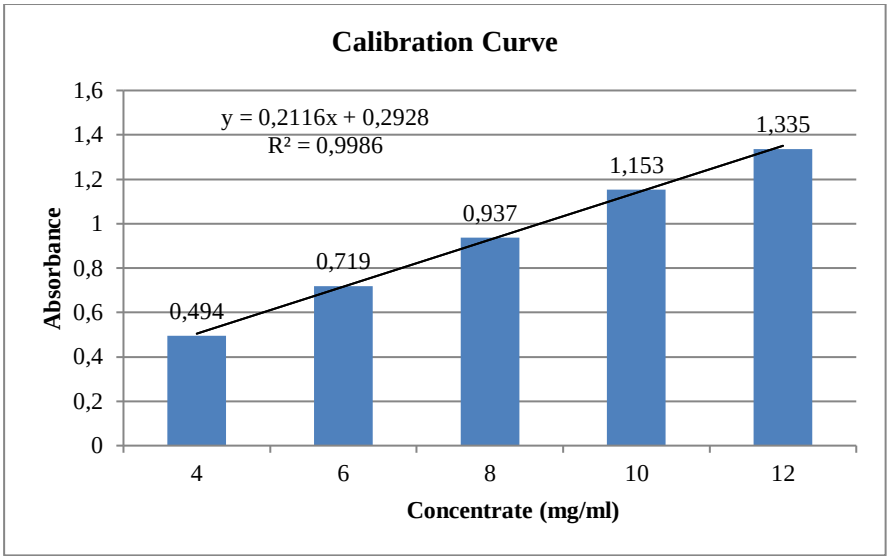

Figure 1. Standard Solution Calibration Curve

From the curve regression equation calculation, the researchers obtained the line equation of $y = 0{,}211x + 0{,}291$, with a correlation coefficient (r) of 0.998. This equation can be used to determine the vitamin C content of the extract by finding the value for x and entering the absorbance value in y. The data for vitamin C levels in tree sorrel extract in mg/ml units are displayed in Figure 2.

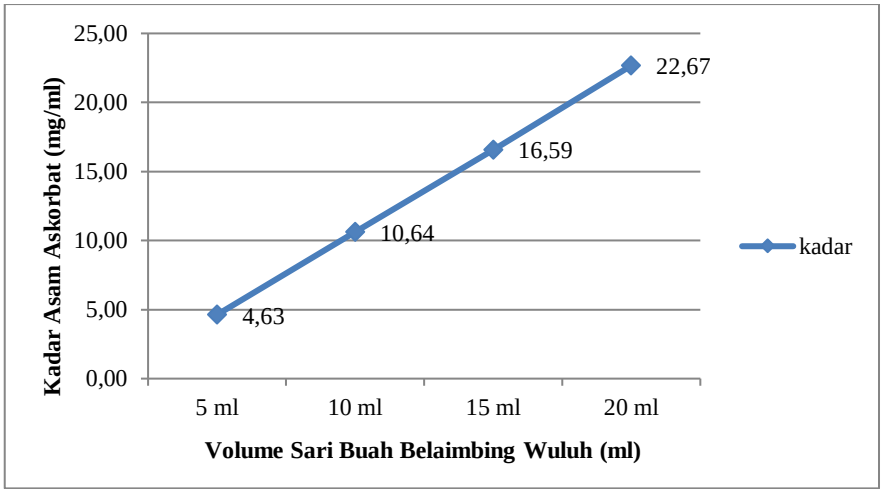

Figure 2. Vitamin C content of Tree Sorrel Extract

Figure 2 displays the result of calculating vitamin C levels in tree sorrel extract. The graph shows the difference in the amount of vitamin C in each volume. The calculation results of the highest vitamin C were at a volume of 20 ml (22.58 mg/ml), and the lowest level was at a volume of 5 ml (4.61 mg/ml).

The calculation of clotting time was used to determine the effective coagulant. The calculation of the latex clotting time began when the latex was mixed with the coagulant and then homogenized. Furthermore, the clotting time was calculated using a stopwatch.

Figure 3 displays the latex clotting time with tree sorrel extract (Averrhoa bilimbi) using a ratio of 5 ml:20 ml, 10 ml: 20 ml, 15 ml: 20 ml, and 20 ml: 20 ml.

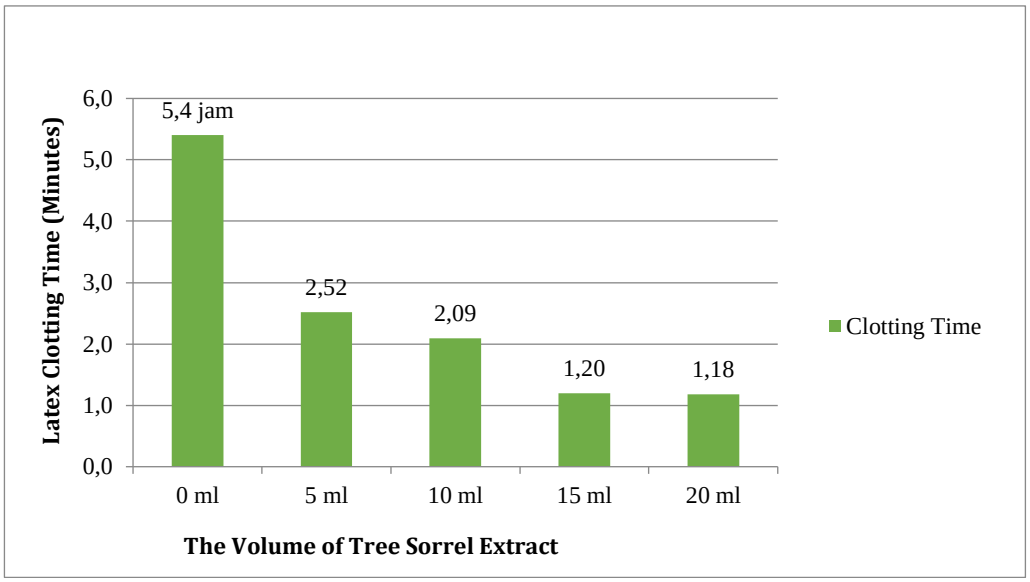

Figure 3. Latex Clotting Time.

Figure 3 displays the latex clotting time with various concentrations of tree sorrel extract. The results were different in each treatment. The fastest time was in the treatment of 20 ml extract (1.18 minutes). The latex weight with a ratio of 5 ml: 20 ml, 10 ml: 20 ml, 15 ml: 20 ml, and 20 ml: 20 ml in the fifth hour can be seen in Figure 4.

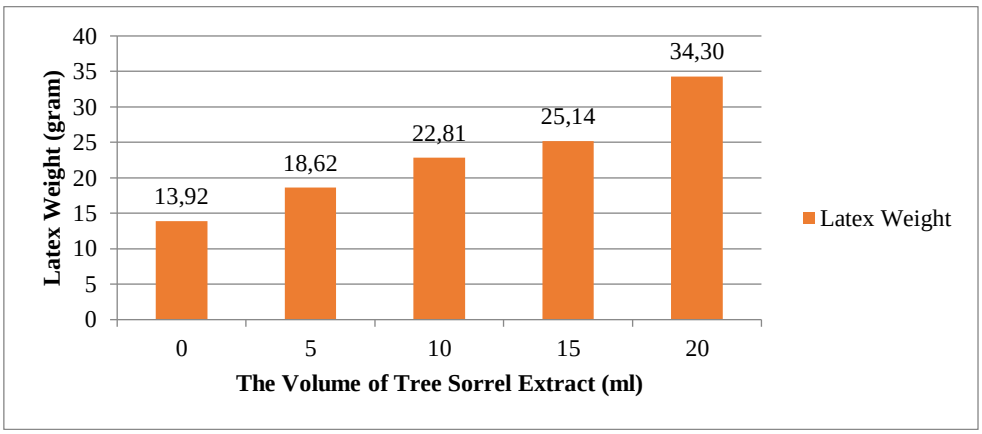

Figure 4. Latex Weight after the Fifth Clotting Hours

Figure 4 is the result of measuring the weight of latex with different extract concentration ratios. The highest weight was found in 20 ml extract, while the lowest was in the treatment without fruit extract (13.92 grams).

The research consisted of two stages: the pre-research stage and the actual research stage. The pre-research stage was conducted to determine the coagulants used by farmers in Negeri Katon, Pesawaran Regency. From the pre-research results, the farmers used chemical's acidic nature of the coagulant. This method is not suitable for the price of rubber. In the last five years, the decrease in rubber prices has forced farmers to purchase chemicals, thereby reducing their income. Besides being expensive, it is also dangerous for the farmers themselves.

Based on the results of the pre-research, the researchers were looking for natural coagulant alternatives that could be easily

obtained. The coagulant used as a sample was tree sorrel (Averrhoa bilimbi) because this fruit was easy to obtain. This coagulant is based on its acidic nature. One of the factors that cause latex to coagulate is when the latex pH is lowered to 4-5 (Edison, 2016). Also, it contains ascorbic acid (vitamin C), which has the potential of a latex coagulant. This fact is based on previous research that utilized ascorbic acid found in pineapple extract (Farida Ali, Arta Sihombing, 2013).

pH analysis was carried out to determine the level of acidity in the coagulant to be sampled. The analysis results showed that the pH of the tree sorrel extract was 1.34. According to (Resty Rahayu, Noviar Harun, 2018), the sorrel tree has a pH of 2.18 – 4.5, which shows that tree sorrel has a high acid level, so it is rarely consumed except as a cooking spice. The degree of acidity will affect the levels of vitamin C contained therein (Achyadi, 2019).

The degree of acidity was tested to see the level of acidity. The acidic nature helps speed up the coagulation time, and the addition of coagulant will affect the weight of the latex. The low pH of tree sorrel extract or high acidity can reduce the pH of the latex so that latex can coagulate faster. A similar theory is stated by (Hendra et al., 2014) that the acidic nature can lower the pH of the latex so that the latex coagulates quickly.

The calculation results obtained through the calibration curve in the observed image (Figure 1) show various vitamin C content in various coagulant concentrations of tree sorrel extract. Based on the analysis, the greater the concentration of the extract, the higher the levels of ascorbic acid will be. Therefore, the degree of acidity will affect the value of ascorbic acid (vitamin C) since the more acidic the sample, the higher the ascorbic acid content will be.

Testing the ascorbic acid content of tree sorrel extracts should be cautioned because ascorbic acid or vitamin C is very soluble in water. When subjected to cutting, washing, and boiling, the vitamin C level will easily decrease. The vitamin C in food and fruit will be damaged due to the oxidation process, especially when heated (Pakaya et al., 2014). Therefore, the tree sorrel extract was stored at low temperatures (in the freezer or refrigerator and not exposed to light) during the research by covering it with aluminum foil.

The coagulation process is a fundamental way of processing latex. In agriculture, selling rubber is usually in the form of lumps or when the rubber has clotted, so the rubber sap must undergo coagulation. Coagulation can occur with the help of coagulation agents to shorten the clotting time.

The data analysis showed differences in the latex clotting time using various volumes of tree sorrel extract. Based on Figure 3, the average latex coagulation showed significant differences due to the addition of coagulants at various concentrations of tree sorrel extract.

The treatment with the fastest clotting time was the treatment with 20 ml of tree sorrel extract with an average time of 1.18 minutes. The acid value of the coagulant influenced the speed. The analysis showed that the pH of the tree sorrel extract was 1.34. Furthermore, vitamin C levels affect coagulation time (selpiana et al., 2015). The vitamin C content in the 20 ml of tree sorrel extract, 22.67 mg/ml, is greater than the volume concentration of other fruit extracts.

The 20 ml of tree sorrel extract treatment had significantly different results from other treatments. The relationship between latex particles and coagulants increased and caused latex to clot quickly. The more acid used, the faster the decrease in the electrical charge of the latex molecule. The decrease in latex pH occurs at the isoelectric point. Proteins in latex that lose their charge will experience denaturation so that the protein sheath that functions to protect the latex particles will collide and cause coagulation (Arta Sihombing, 2013)

At the control negative treatment (0 ml), the clotting required a longer time due to inexistent of compounds that unite the latex grains. Latex utilizes proteolytic enzymes to

break peptide bonds into amino acids (Farida Ali, Arta Sihombing, 2013). This process causes the rubber particles to lose their sheath and become uncharged so that they are unstable and then agglomerate. In the negative control treatment of 0 ml, the clotting time required the longest duration because no substance unites the latex grains.

The measurement of latex weight was performed to determine the potency of vitamin C at various concentrations of coagulant. Time susceptibility was used as an alternative to getting the optimum weight of coagulated latex. The researchers calculated the latex weight within several time spans: the first, second, third, fourth, and fifth hours. From the first to the fifth hours, the weight decreased. This decrease occurred due to the loss of water content. Therefore, the more water content produced during coagulation, the lower the rubber weight (Farida Ali, Arta Sihombing, 2013).

The analysis showed that the addition of tree sorrel extract affected the weight of the latex that. Figure 4 displays significant differences between treatments. The treatment with the largest latex weight was at a volume of 20 ml with an average weight of 34.30 grams. At that volume, tree sorrel extract is quite stable so that the interaction between water and acid increases. Therefore, the dispersed particles will be easier to combine to form larger aggregates, causing the rubber weight to increase and produce optimum rubber weight (Farida Ali, Arta Sihombing, 2013).

No addition of coagulant produced the lowest latex weight. It was due to pure latex coagulated for a long time and caused a lot of water to be released. Table 4 shows the average latex weight difference after experiencing coagulation at the fifth hour of observation time. The treatment that had the largest and most effective weight was found in tree sorrel extract with a concentration of 20 ml. that particular concentration contained more vitamin C than the 15 ml, 10 ml, and 15 ml treatments. The vitamin C of tree sorrel potentially increases the weight of the latex produced because the higher the level of ascorbic acid, the more rubber particles will stick together.

Farmers can apply tree sorrel extract. Besides being easy to obtain and use, this coagulant can also increase the weight of latex. This coagulant also produced the most effective clotting time; thus, the latex sold will have a greater value.

CONCLUSIONS AND RECOMMENDATIONS

Based on the research and discussion, vitamin C from tree sorrel (Averrhoa bilimbi) extract is potential as a latex coagulant. The larger the extract volume, the more effective it is as a coagulant. Treatment with 20 ml of tree sorrel extract had the best clotting time and weight, namely 1.18 minutes and 34.30 grams. On the other hand, the treatment with the lowest yield was found in the 5 ml volume, with a clotting time of 2.52 minutes and a weight of 18.62 grams. The control without coagulation material had the longest clotting time and the lowest latex weight.

It is suggested to research latex clotting locations adjacent to rubber plantations. This will determine coagulation quality because the latex is still in normal condition without being precoagulated.

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